The Characteristic Elements of Plants (Pueraria Iobata OHWI) in the Artificial Slope

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The Characteristic Elements of Plants (*Pueraria lobata* OHWI) in the Artificial Slope

NANAE KOJI
Graduate school of Natural Sciences and Technology, Kanazawa University, Kanazawa, Ishikawa, 920-1192 JAPAN
KAZUE TAZAKI
Department of Earth Sciences, Kanazawa University, Kanazawa, Ishikawa, 920-1192 JAPAN

Abstract – Perennial herb, *Pueraria lobata* OHWI have been flourished at an artificial slope beside pond in the Kakuma Campus of Kanazawa University, Ishikawa prefecture, Japan. We collected pea pods, stems, and roots, and soil near the plants to research the behavior of the characteristic element in and around the plants. SEM-EDX analysis revealed that fibrous substance attached with the surface of root, and the substance contained high concentration of Al.

I. Introduction

Solid Aluminum in acidity soil is changed into Al^{3+} ion affecting strong toxicity to a plant by dissolving soil in the acid water [1] [5]. When roots of plant are soaked in Al^{3+} solution of μM level, the root is prevented from growth within several hours.

Many artificial slopes have been made when constructing the road in Japan. These artificial slopes are often revegetated by plants such as herb seed for prevention of the collapse of the soil surface and preservation of the ecology and the landscape [2]. However, relationships between soil of artificial slopes and plants avoiding soil erosion is often neglected and not well understood. In this study, the distribution of the characteristic element in and around a *Pueraria lobata* OHWI, was investigated. The plant flourishs at an artificial slope around Kakuma Campus of Kanazawa University, Ishikawa prefecture, Japan.

II. Sample and Methods

Roots, stems, and pea pods of *Pueraria lobata* OHWI, and soil around the roots were collected from an artificial slope of a pond in the Kakuma Campus of Kanazawa University, Ishikawa prefecture, Japan. The roots, stems, and pea pods were washed with deionized water to remove soil adhering to the surfaces. In addition, these samples were washed by ultrasonic waves. After air-drying, all samples were analyzed.

The chemical compositions of all samples were analyzed by an energy dispersive X-ray fluorescence spectrometer (ED-XRF; JEOL JSX 3201). The samples were ground to fine powder and were mounted on the Mylar film. The powder samples were analyzed using Rh-Kα generated at 30kV under a vacuum condition.

Contents of N, C, and S in samples were analyzed using automatic gas chromatographic elemental analyzer (CE Instruments NA 2500-NCS). With a combustion of 20 ml oxygen at 1000℃, each powder sample (2 mg) were used.

The mineralogical properties of samples were analyzed by X-ray powder diffractometer (XRD; Rigaku RINT 2000) with Cu Kα generated at 40kV and 30mA using the 2θ/θ and with a scanning speed 2°/min. The powder of soil sample was mounted onto slide glass to fit the diffractiometer sample-holder. On the other hand, the plants samples were made into paste with water, and were applied to glass slides.

Scanning electron microscopic observation and energy-dispersive X-ray spectroscopy (SEM-EDX).

Freeze-dried method was used for sample preparation [3]. After roots, stems, and pea pods of *Pueraria lobata* OHWI were cut, the cut fragments were putted onto JEOL filter. The fragments were fixed with 2.5 % glutaraladehyde solution for 10 minutes, rinsed four times with distilled water, and were dehydrated in a *t*-butyl alcohol for 5 minutes. The dehydrated samples were frozen in liquid nitrogen, and then dried up with low-vacuum desiccator. After the completion of freeze-drying, the samples were transferred on cupper-stub with carbon tape, coated with carbon and observed with a scanning electron microscope (SEM; JEOL JSM-5200LV), equipped with an energy dispersive X-ray spectrometer (EDX; Philips-EDX PV9800 STD).

Fig. 1. A photograph of *Pueraria lobata* OHWI at Kakuma campus of Kanazawa University, Ishikawa, Japan.

III. Results and Discussion

The ED-XRF analysis of soil contained high quantity of Si and Fe with trace of Al, K, and Ca. Whereas pea pods stems, and roots of , *Pueraria lobata* OHWI , contained hight quantity of Ca and K with traces of Si, Fe and Al. Specifically the Ca content is high in the pea pod. On the other hand Fe and Al decreases from root toward upper part, pea pod. (Fig.2).

NCS analysis of *Pueraria lobata* OHWI samples revealed that All contents of N, C, and S in stems were low in comparision with pea pods and roots Whereas N and S were detected in the soil.

Fig.3 shows XRD profiles of the four samples. The pea pods, roots and adhesive materials on root, and soil around the roots were analyzed by XRD. Adhesive materials on root were removed from the roots by ultrasonic waves, and then, were collected by centrifugal speoatration. it was collected in ultrasonic waves water, It is the water after washed the roots, useing centrifugal separation. The three samples of *Pueraria lobata* OHWI showed the presence of amorphous or poorly crystalline materials, suggesting opal A (around 4.01 Å). In particular XRD pattern of pea pods showed the diffraction of calcium minerals, Whewellit (5.78 and 3.64Å) [4]. Another parts of *Pueraria lobata* OHWI samples also concentrated high Ca, were not found Whewellit. but also XRD pattern of root shows the hilly buck ground, suggested opal A (3.92 Å). The XRD pattern of the immediate materials of root also showed presence of clay minerals (9.99 Å 14.24 Å), silicic amorphous peak, opal A (around 4.05 Å), cristobalite (4.05 Å) and quatz (3.34 Å). Whereas XRD pattern of Soil samples around *Pueraria lobata* OHWI indicated diffraction peaks of smectite, chloriteor or vermiculite clay minerals (14 Å), amphibole (6.39 Å), feldspar (3.18, 4.04 and 3.76 Å) and quartz (3.34, 4.26, and 1.81 Å).

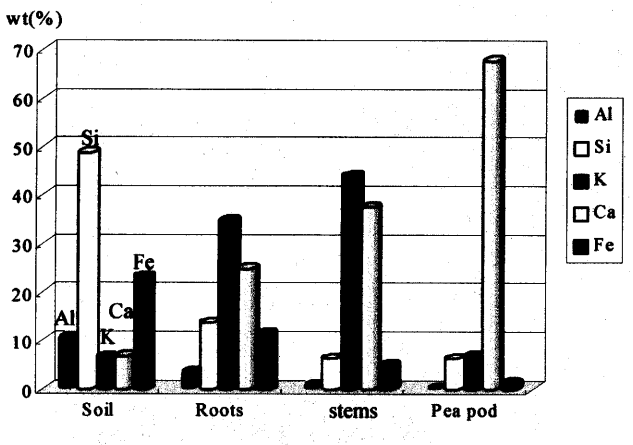

Fig. 2. A bar chart of chemical composition in soil, roots, stems and pea pods by ED-XRF analysis.

TABLE I
Nitrogen, Carbon and Sulphur composition of the soil, roots, stems and pea pods by NCS analyzer (wt%)

	Nirtrogen	Carbon	Sulphur
pea pod	1.46	44.48	0.04
steams	0.55	42.53	n.d.
roots	1.90	43.89	0.10
soil	n.d.	0.54	n.d.

n.d. : not detected

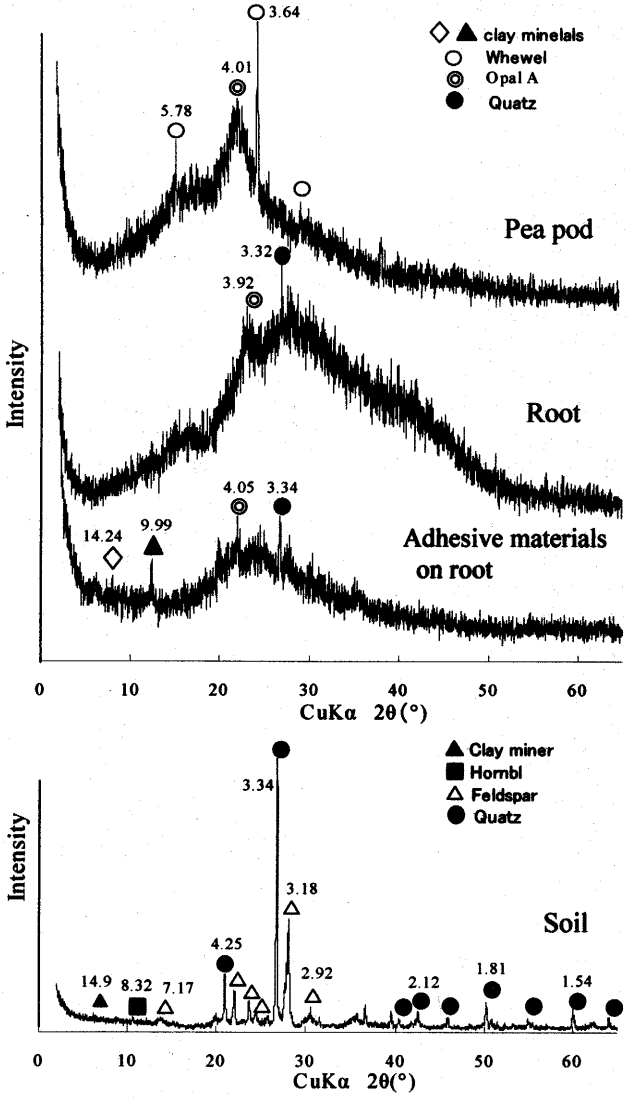

Fig. 3. The X-ray powder diffraction patterns of pea pods and roots of *Pueraria lobata* OHWI, and adhesional materials on roots and soil.

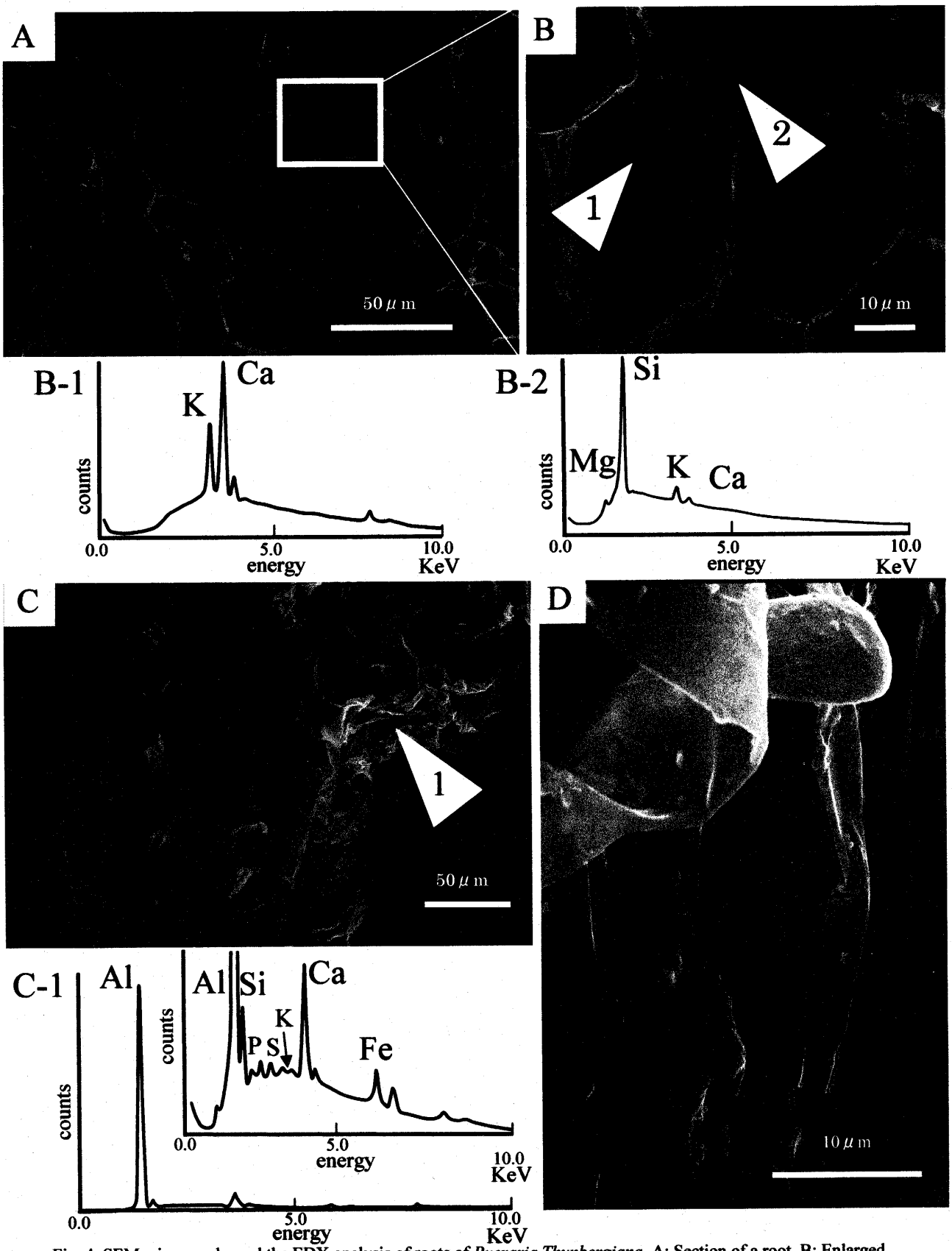

Fig. 4. SEM micrographs and the EDX analysis of roots of *Pueraria Thunbergiana*. A: Section of a root, B: Enlarged micrograph of enclosure in Fig.4A. C: Surface of a root, D: Fibrous substance of film-like structure found on the surface of a root in Fig. 4C
B-1 and B-2: EDX-Spectra of spheical materials (arrow 1) in Fig. 4 B and
C-1: EDX-spectrum of film-like substance in Fig. 4 C (arrow).

Fig .4 shows SEM micrographs and the EDX analysis. cross section of observation (arrow A, B) showed framework structures, suggesting cell wall. In the structure, there are spherical materials, 1 ~ 2 μm in size, composed of K and Ca. In some case, the structures were fill with cells (2), 10 ~ 20 μm in size, composed Mg, Si, Ca, K. Whereas SEM observation of the root surface (Fig4C,and D) revealed film like structures, about 50 μm in length. The film like structures contained high concentration of Al with traces of Si, P, S, K, Ca and Fe. It was revealed that Al is concentratopn film like stractures the root surface.

V. Conclusion

Chemical composition of soil around *Pueraria lobata* OHWI indicate Si with traces of Fe, Al, K, and Ca. Whereas, *Pueraria lobata* OHWI of stems and roots have high concentrarions of K and Ca with traces of Si, Fe, and Al. Ca content of pea pod is the highest concentration in all plants samples.

X-ray powder diffraction of three samples of *Pueraria lobata* OHWI shows amorphous peak, opal A (around 4.01 Å). Especially pea pod shows the presence of whewelight (5.78 Å and 3.65 Å) and opal A (around 4.01 Å).

All *Pueraria lobata* OHWI samples, pea pods, stems, and roots, contain Al content. But the samples containing highest aluminum content is a root. Furthermore as a result of SEM, the film-like structures attached to surface of root contained high Al content.

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